LBO-51MA

DISPLAY

SERVICE MANUAL

****

NOTE

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the service manual unless you are qualified to do so.

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1st edition Aug., 1986

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1. SPECIFICATIONS

Vertical and Horizontal Amplifiers

Deflection Sensitivity	50 mV/div, adjustable from 50 mV/div to 150 mV/div (via front-panel screwdriver adjustment)
Accuracy	+3%
Bandwidth	
DC Coupled	DC to 3 MHz, −3 dB, 5 div ref
AC Coupled	2 Hz to 3 MHz, −3 dB, 5 div ref
Rise Time	Less than 120 nS
Phase Shift	Less than 3 deg. at 1 MHz, 8 div ref
Linearity	Within 5%
Input Coupling	AC or DC, selected by internal switching (supplied in DC position)
Input Impedance *	1 megohm ±2%, less than 50 pF
Maximum Input Voltage	100 V (DC + AC peak)
Polarity	Internally switchable

Z-Axis (Intensity)

Sensitivity	±1V
Bandwidth	DC to 4 MHz
Rise Time	Less than 90 nS
Input Impedance	1 megohm ±2%, less than 50 pF
Maximum Input Voltage	100 V (DC + AC peak)

CRT Display

Display Area	8 cm H X 10 cm W
Graticule	Removable, 8 div H X 10 div W (1 div = 10 mm)
Brightness	25 fL (measured with 60 Hz refresh rate and 100-line raster)
Spot Size	0.26 mm at 0.5 μA beam current
Accelerating Voltage	7 kV/2 kV (stabilized)
Phosphor *	P31

Physical and Environmental Data

Power Requirements	117 V ±10%, 50/60 Hz (Accomodates 100, 220, 240 V supplies by power transformer tap selection)
Power Consumption	25 watts (maximum)
Dimensions	8.4 in. (215 mm) W X 5.125 in. (132 mm) H X 17.5 in. (450 mm) D
Weight	14.3 lbs (6.5 kg)
Operating Temperature	0 deg. C to 50 deg. C (32 deg. F to 122 deg. F)
Storage Temperature	−20 deg. C to 70 deg. C (−4 deg. F to 162 deg. F)
Accessories Furnished	Blue CRT filter plate (without graticule) Instruction manual Fuse
Available Options	Type of CRT phosphor CRT internal graticule(or graphics supplied by user) X-Y axis sensitivity (attenuated) X-Y-Z input terminations Z-axis input polarity Z-axis TTL input level sensitivity (+5 V)

* Standard configuration

2. TEST EQUIPMENT REQUIRED

The following test equipment is required for calibration and servicing of the Model LBO-51MA. The suggested specifications are the minimum necessary for proper calibration of this instrument.

Test Equipment	Minimum Spec
- Multimeter	0 - 200V Accuracy <1% *LEADER Model LDM-853A High voltage probe *LEADER Model LP-6
- Oscilloscope	10mV sensitivity 50MHz bandwidth Low capacitance probe *LEADER Model LBO-526
- Sine Wave Generator	10Hz - 4MHz
- Amplitude Calibrator	200mV Square wave *LEADER Model LOC-7005

3. CALIBRATION PROCEDURE

3.1 General

Calibration should be performed after a 30 minute warm-up period. It should also be confirmed that the unit is connected to the rated power line voltage.

All adjustments should be completed in the given order, because some adjustments interact with others.

During the adjustment procedure, remove the case only when necessary and replace immediately after making an adjustment. This will maintain all circuits at constant operating temperature.

Take utmost precaution to come into contact with the high voltage circuits!

3.2 Initial Control Settings

The initial control settings to be used for each check and adjustment are listed below. Any variations from these settings are stated in the applicable procedure.

Y-AXIS	
POSITION	Center
GAIN	Fully clockwise
X-AXIS	
POSITION	Center
GAIN	Fully clockwise
INTEN	As desired
FOCUS	Best focused display

3.3 Power Supply

- Connect the DC voltmeter between test point on the pc board(T-2510) and chassis.

- Adjust as required, using the adjustment shown in Table 3-1.

Test point	Voltage	Tolerance	Adjustment
TP1	+150V	+140V to +160V	-
TP2	-15V	-14.1V to -15.9V	-
TP3	+15V	+14.4V to +15.6V	-
TP4	-1900V	-	VR2

Table 3-1

3.4 Display

(1) Intensity Adjustment

- Set: INTEN — Midway between 10 and 11 o'clock position
- Adjust VR1(T-2510) so the trace is just visible.

(2) Focus Adjustment

- Set: INTEN — 1 o'clock position
  FOCUS — Center
- Connect the sine wave generator to X and Y INPUT connectors and set the frequency to 1kHz, output level for 8 x 8 divisions display.
- Adjust VR3(T-2510) for optimum trace sharpness.
- Adjust ASTIG control and VR5(T-2510) alternately to obtain a best focused display.

3.5 Y- AXIS

(1) Bias Adjustment

- Connect the DC voltmeter between pin 1 and 3 of P12(T-2510).
- Set the Y POSITION control for a meter reading of 0V.
- Remove the DC voltmeter, then reconnect it between either pin 1 or 3 of the P12 and chassis.
- Adjust VR11(T-2510) for a meter reading of +90V.

(2) DC Balance Adjustment

- Set: Y-AXIS
  GAIN — Fully counterclockwise
- Position the trace to the center horizontal graticule line using the Y-AXIS POSITION control.
- Rotate the GAIN control to fully clockwise
- If the spot moves 1 division or more, adjust VR1(T-2511) for minimum trace shift between both extremes of the POSITION control settings.

(3) Sensitivity Adjustment

- Set: Y-AXIS
  GAIN Fully clockwise
- Connect the amplitude calibrator to Y-AXIS INPUT connector and set the output level to 200mVp-p.
- Adjust VR2(T-2511) for 4 divisions display.

(4) Frequency Response Check

- Set: Y-AXIS
  GAIN Fully clockwise
- Connect the sine wave generator to Y-AXIS INPUT connector via suitable terminator and set the frequency to 1kHz, output level for 5 divisions display.
- Increase the frequency until the trace length decreases to 3.5 division and observe the generator frequency is greater than 3MHz.

3.6 X-AXIS

(1) Bias Adjustment

- Connect the DC voltmeter between pin 1 and 3 of P11(T-2510).
- Set the X POSITION control for a meter reading of 0V.
- Remove the DC voltmeter, then reconnect it between either pin 1 or 3 of the P11 and chassis.
- Adjust VR12(T-2510) for a meter reading of +90V.

(2) DC Balance Adjustment

- Set: X-AXIS
  GAIN Fully counterclockwise
- Position the trace to the center vertical graticule line using the X-AXIS POSITION control.
- Rotate the GAIN control to fully clockwise
- If the spot moves 1 division or more, adjust VR3(T-2511) for minimum trace shift between both extremes of the POSITION control settings.

(3) Sensitivity Adjustment

- Set: X-AXIS
  GAIN Fully clockwise

- Connect the amplitude calibrator to X-AXIS INPUT connector and set the output level to 200mVp-p.

- Adjust VR4(T-2511) for 4 divisions display.

(4) Frequency Response Check

- Set: X-AXIS
  GAIN Fully clockwise

- Connect the sine wave generator to X-AXIS INPUT connector via suitable terminator and set the frequency to 1kHz, output level for 5 divisions display.

- Increase the frequency until the trace length decreases to 3.5 division and observe the generator frequency is greater than 3MHz.

3.7 X-Y Phase Adjustment

- Set: X-AXIS
  GAIN Fully clockwise
  Y-AXIS
  GAIN Fully clockwise

- Connect the sine wave generator to X and Y INPUT connectors with matching-length cables and set the frequency to 1MHz, output level for 8 x 8 divisions display.

- Adjust VC2(T-2511) to eliminate any double-trace effect visible in the mid-portion of the display.

3.8 Z-AXIS

- Connect the test oscilloscope to TP5(T-2510) with DC coupled input mode and set the vertical sensitivity to 0.5V/DIV. Use well-compensated low capacitance probe.

- Connect the sine wave generator to Z INPUT connector and set the frequency to 1kHz, output level for 4 divisions (20Vp-p) display on the test oscilloscope.

- Adjust INTEN control for a DC level as shown in Figure 3-1.

- Increase the frequency until the sine wave amplitude decreases to 2.8 division(14Vp-p) and observe the generator frequency is greater than 4MHz.

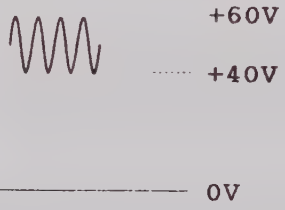


Figure 3-1

4. TROUBLESHOOTING PROCEDURE

4.1 Troubleshooting Aid-1

Confirm that the any equipment used with the LBO-51MA is operating correctly.

Check all control settings, because an incorrect setting can make a good unit appear defective. If there is any question about the function, refer to the INSTRUCTION MANUAL for a correct operation.

Check all circuit for visual defects such as broken component, loose connection of a connector, open wire, poor soldering etc.

Some troubles can be solved with proper adjustment.

Check the voltage and waveform as shown in the Schematic Diagram to locate the defective circuit. Start with the power supply.
Typical voltage and waveform are obtained under the same conditions as "3.2 Initial Control Settings"

Take utmost precaution to come into contact with the high voltage circuits!

4.2 Troubleshooting Aid-2

The oscilloscope consists of three major sections which are the high voltage power supply, Y-AXIS amplifier and X-AXIS amplifier. In general, if one of these is defective, the trace will not appear on the CRT. Therefore, the most effective procedure is to check these three sections one by one.

The high voltage power supply produces +5kV/-2kVdc to accelerate the electron beam from the electron gun to the face plate of the CRT. If the +5kV/-2kVdc is too low, the spot will either not appear or be dim.

The Y-AXIS and X-AXIS amplifier consist of a pre-amplifier and a final amplifier, all of which are DC coupled balanced circuits. If some portion of the Y-AXIS amplifier becomes unbalanced by a defective component, the spot will be deflected off the face of the CRT. Therefore, it is best to check the state of amplifier balancing when the spot does not appear on the CRT.

4.3 Troubleshooting Aid-3

(1) Overall operation is not satisfactory or no spot appears.

a. Check the power supply voltage within tolerance according to Table 3-1.

Yes: Proceed to "b".

No: Check and troubleshoot on following points.

Line fuse

Secondary voltage of the power transformer

+15V: D3, IC3(T-2510) and associated circuit.

-15V: +15V line, D2, Q4-6, IC2(T-2510) and associated circuit.

+150V: -15V line, D1, Q1-3, IC1(T-2510) and associated circuit.

-1900V: Check the waveform at collector of Q7(T-2510) for 40kHz sine wave and troubleshoot the associated circuit. Check F1 of +22V line. Adjust HV ADJ(VR2 T-2510) if necessary.

b. Connect pin 1 and 3 of P12(T-2510) with short clip lead for balancing check of Y-AXIS amplifier . Spot appears.

Yes: Connect pin 1 and 3 of P10(T-2510) with short clip lead. Spot appears.

Yes- Troubleshoot Pre-amplifier.

No- Troubleshoot Final amplifier. Adjust Y-axis bias(VR11 T-2510) if necessary. Refer to paragraph 3.5(1).

No: Proceed to "c".

c. Connect pin 1 and 3 of P11(T-2510) with short clip lead for balancing check of X-AXIS amplifier. Spot appears.

Yes: Connect pin 9 and 11 of P10(T-2510) with short clip lead. Spot appears.

Yes- Troubleshoot Pre-amplifier.

No- Troubleshoot Final amplifier. Adjust Y-axis bias(VR12 T-2510) if necessary. Refer to paragraph 3.6(1).

No: Troubleshoot CRT control circuit. Adjust CRT bias(VR1 T-2510) if necessary. Refer to paragraph 3.4 (1).

(2) No Y-AXIS deflection or low sensitivity

Connect the amplitude calibrator to Y-AXIS INPUT connector and set the output voltage to 200mVp-p. Set the controls as paragraph "3.2 Initial Control Settings".
Trace the waveform from the input to output stage by using the test oscilloscope to locate the defective circuit.

a. Check waveform at pin 1 of P10(T-2510).
Yes: Troubleshoot Y-axis final amplifier(Q41-47 T-2510).
No: Troubleshoot Pre-amplifier. Adjust sensitivity (VR2 T-2511) if necessary. Refer to paragraph 3.5 (3).

(3) No X-AXIS deflection or low sensitivity

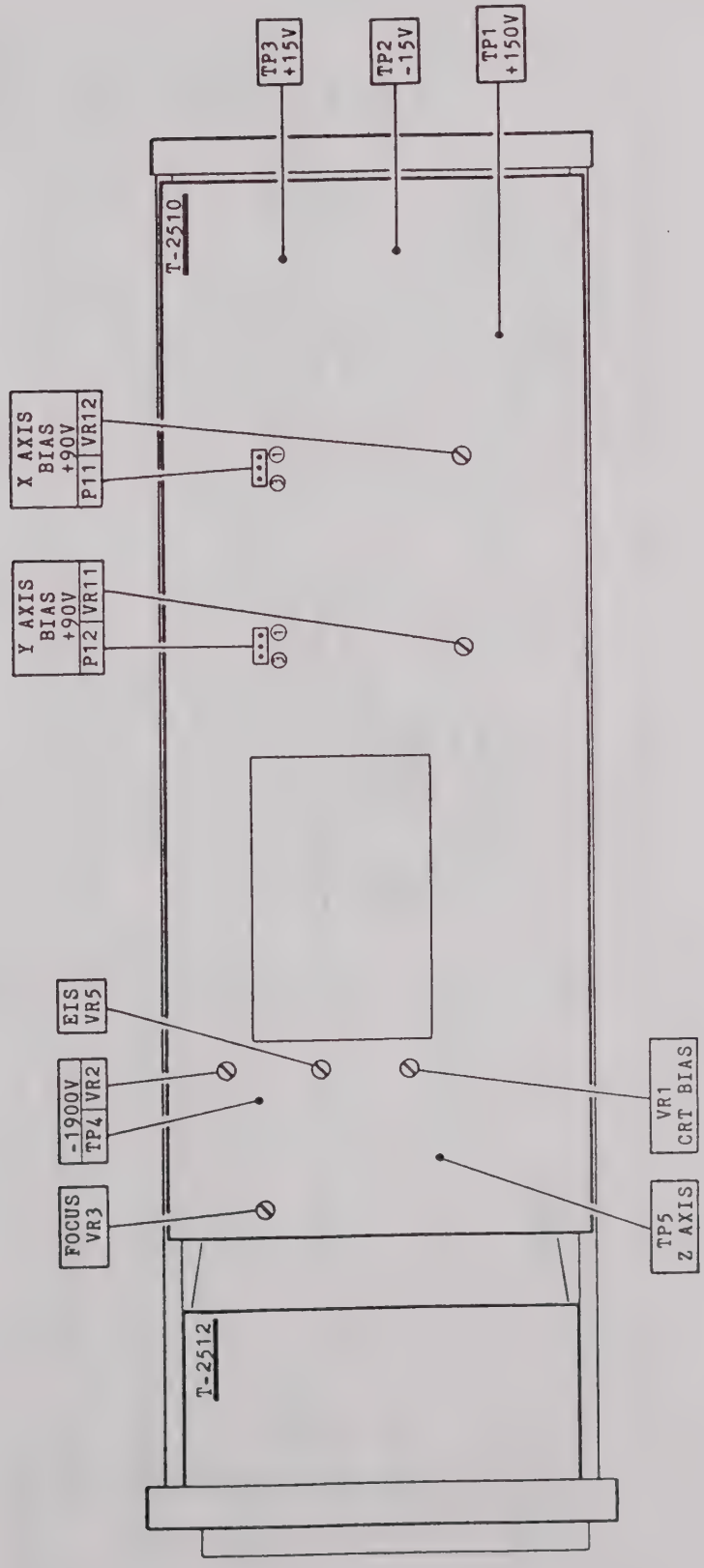
Connect the amplitude calibrator to X-AXIS INPUT connector and set the output voltage to 200mVp-p. Set the controls as paragraph "3.2 Initial Control Settings".
Trace the waveform from the input to output stage by using the test oscilloscope to locate the defective circuit.

a. Check waveform at pin 9 of P10(T-2510).
Yes: Troubleshoot Y-axis final amplifier(Q48-54 T-2510).
No: Troubleshoot Pre-amplifier. Adjust sensitivity (VR4 T-2511) if necessary. Refer to paragraph 3.6 (3).

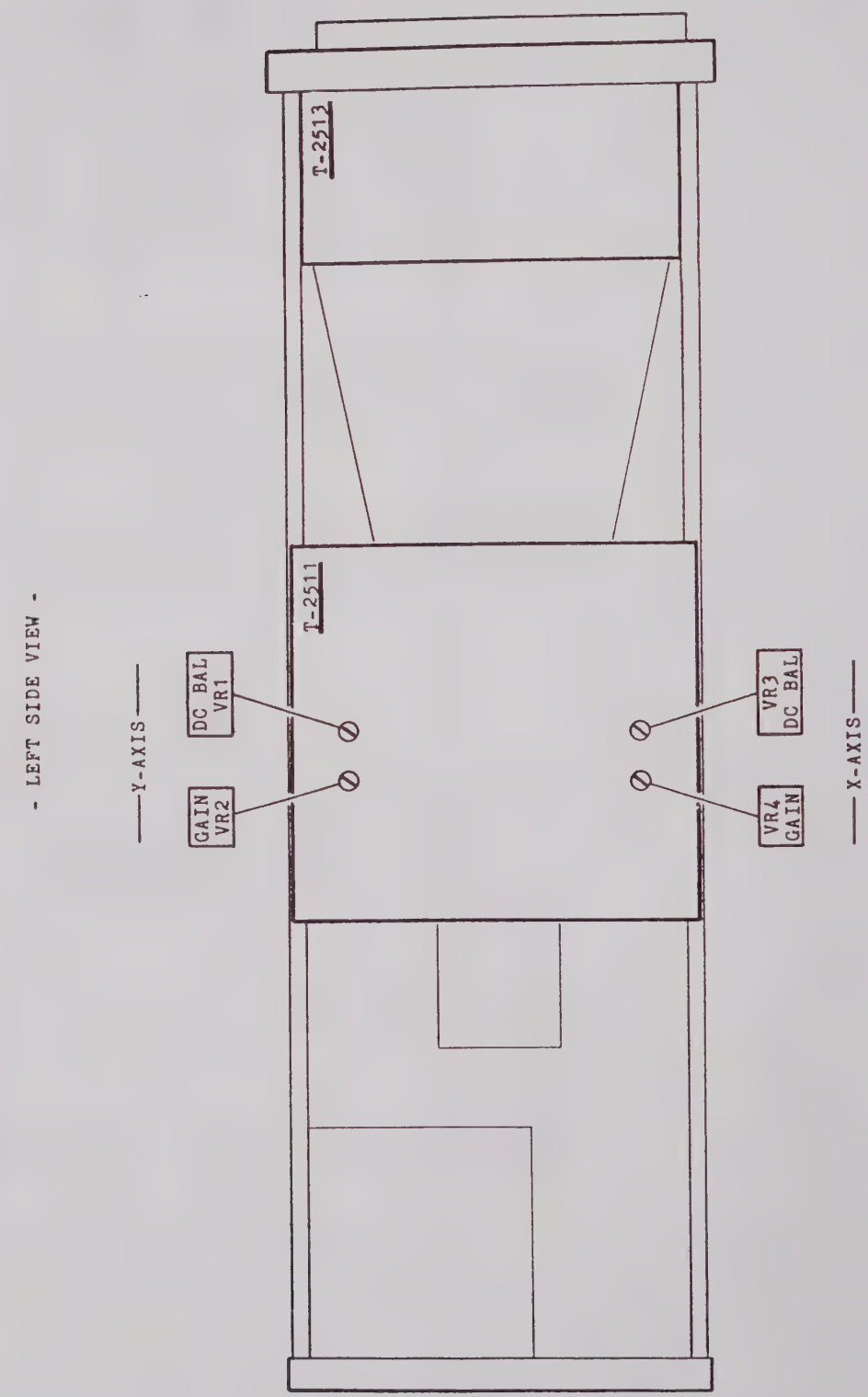
(4) Z-AXIS malfunction

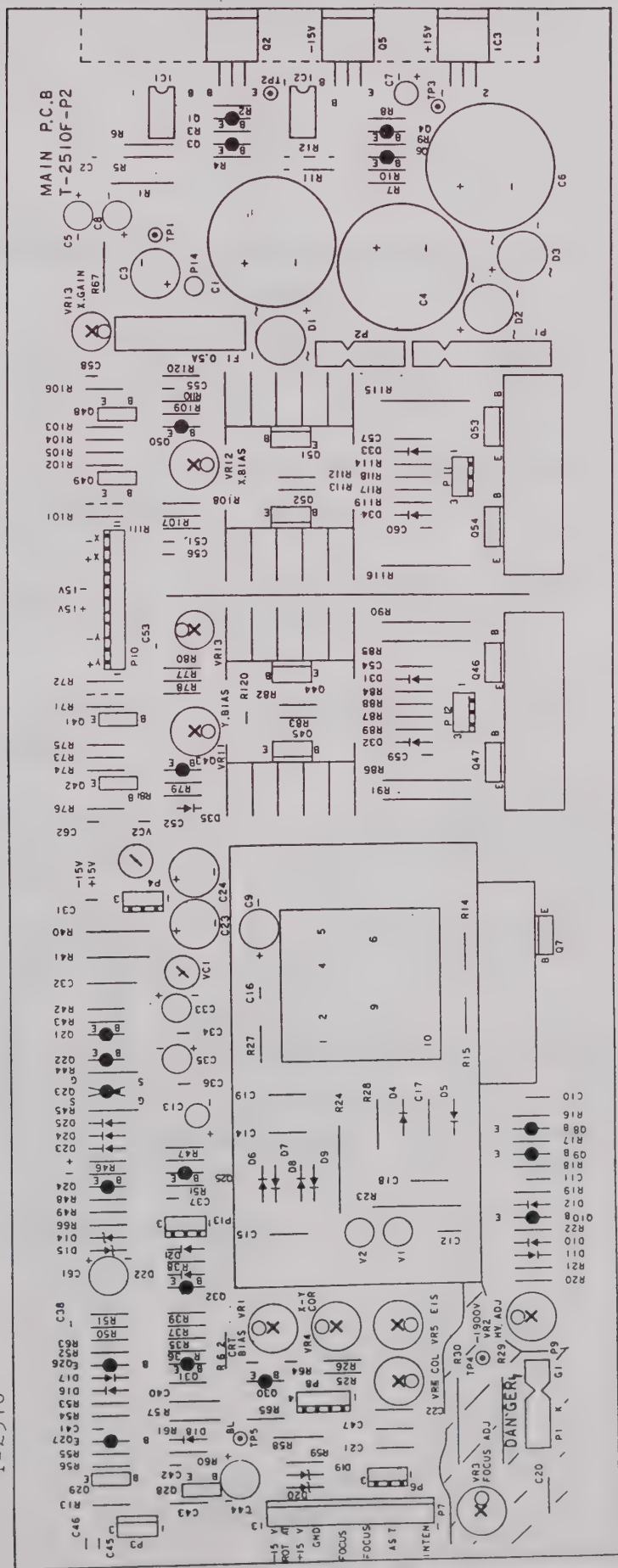
Connect the sine wave generator to Z INPUT connector and set the frequency to 1kHz, output voltage to 1Vp-p.

Check the waveform at TP5 for 24Vp-p sine wave.
Yes: Troubleshoot CRT control circuit
No: Troubleshoot Z-AXIS amplifier

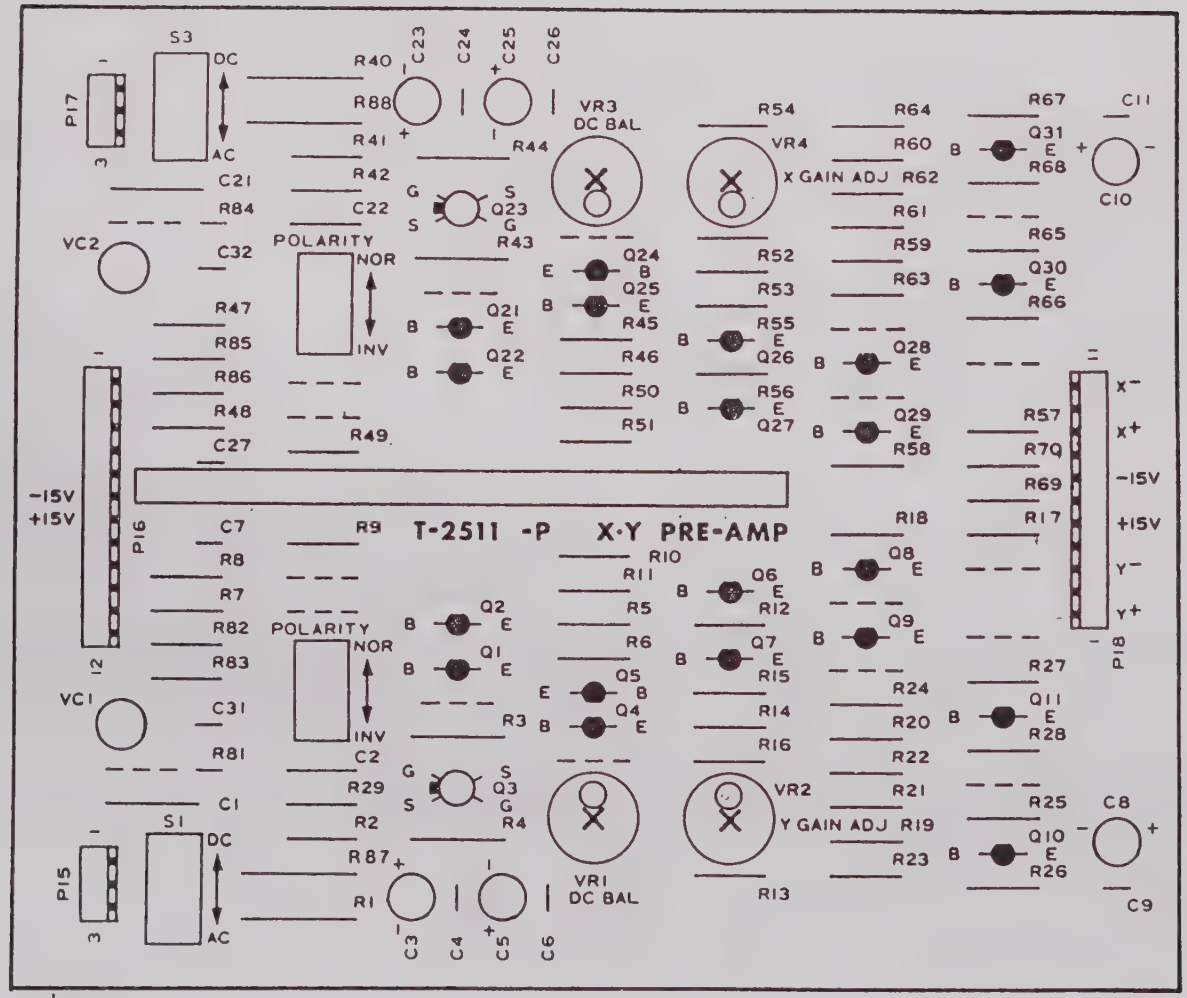


- RIGHT SIDE VIEW -

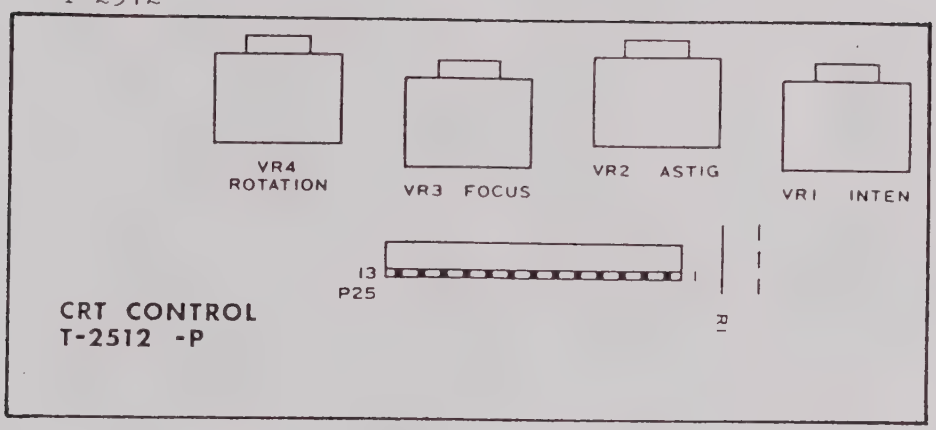

- LEFT SIDE VIEW -
T-2513
T-2511
Y-AXIS
DC BAL VR1
GAIN VR2
VR3 DC BAL
VR4 GAIN
X-AXIS


MAIN P.C.B
T-2510F-P2
T-2510
Top
DANGER
-15-
LBO-51MA

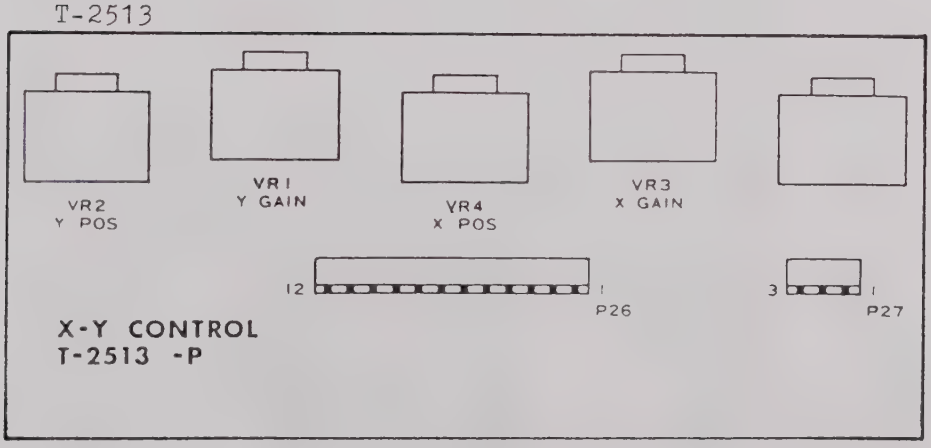
T-2511


T-2511 -P X·Y PRE-AMP
S3
S1
P17
P15
P16
P18
DC
AC
POLARITY
NOR
INV
VR3 DC BAL
VR1 DC BAL
VR4 X GAIN ADJ
VR2 Y GAIN ADJ
VC1
VC2
-15V
+15V
X-
X+
Y-
Y+
Top

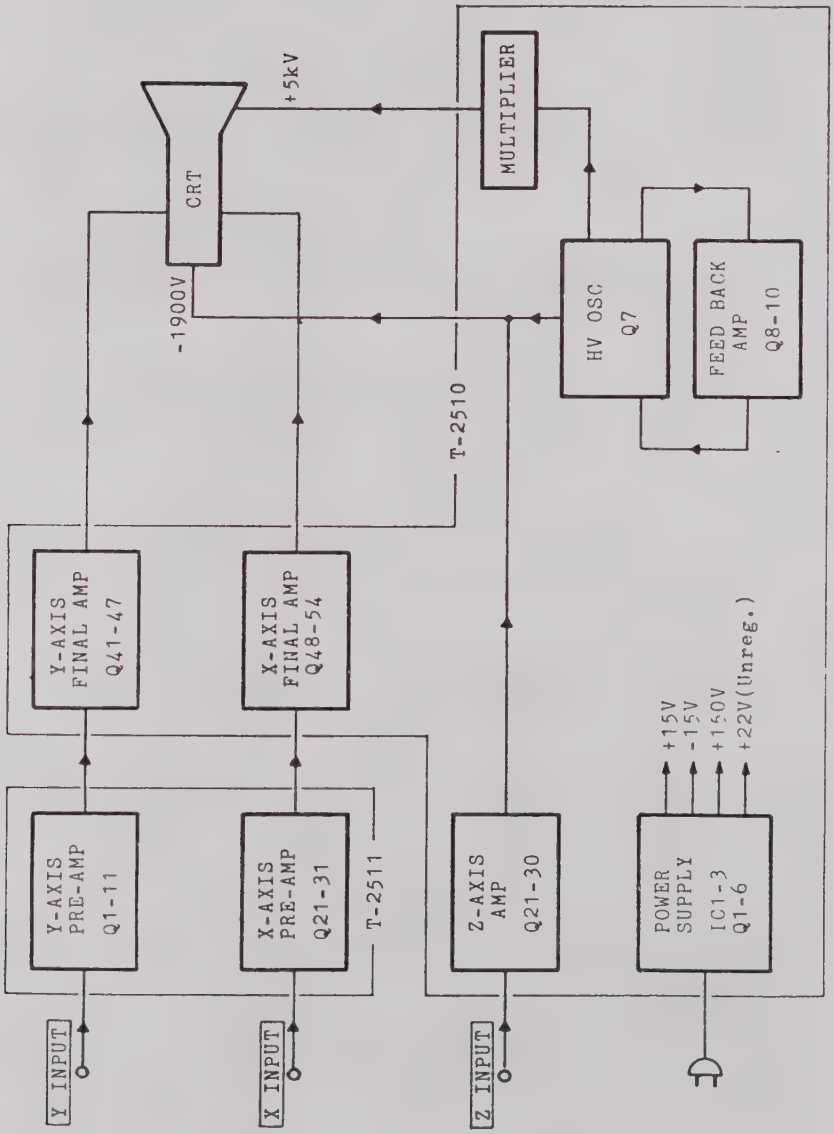
T-2512

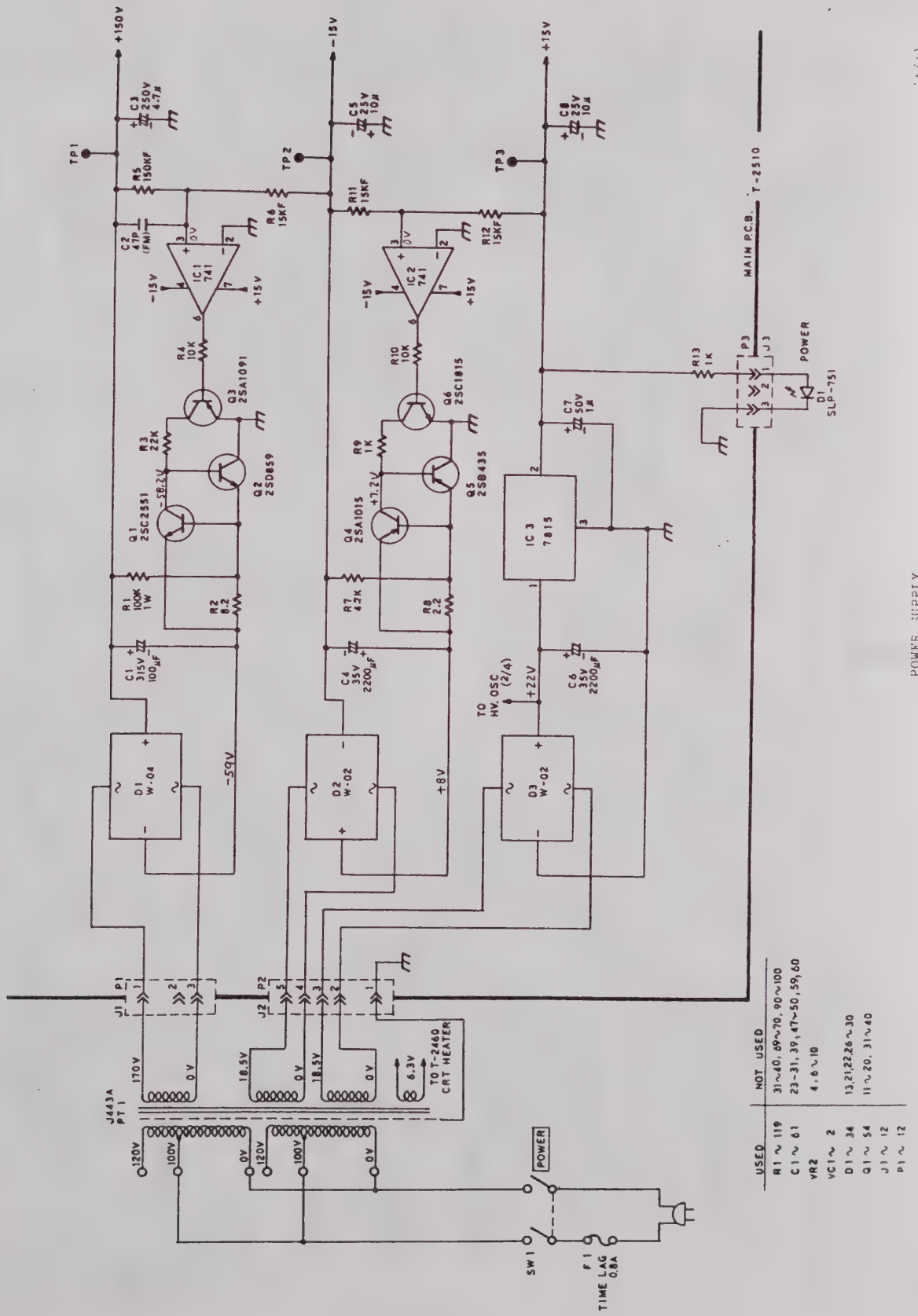

VR4
ROTATION
VR3 FOCUS
VR2 ASTIG
VR1 INTEN
13
P25
1
CRT CONTROL
T-2512 -P

T-2513


VR2
Y POS
VR1
Y GAIN
VR4
X POS
VR3
X GAIN
12
1
P26
3
1
P27
X-Y CONTROL
T-2513 -P

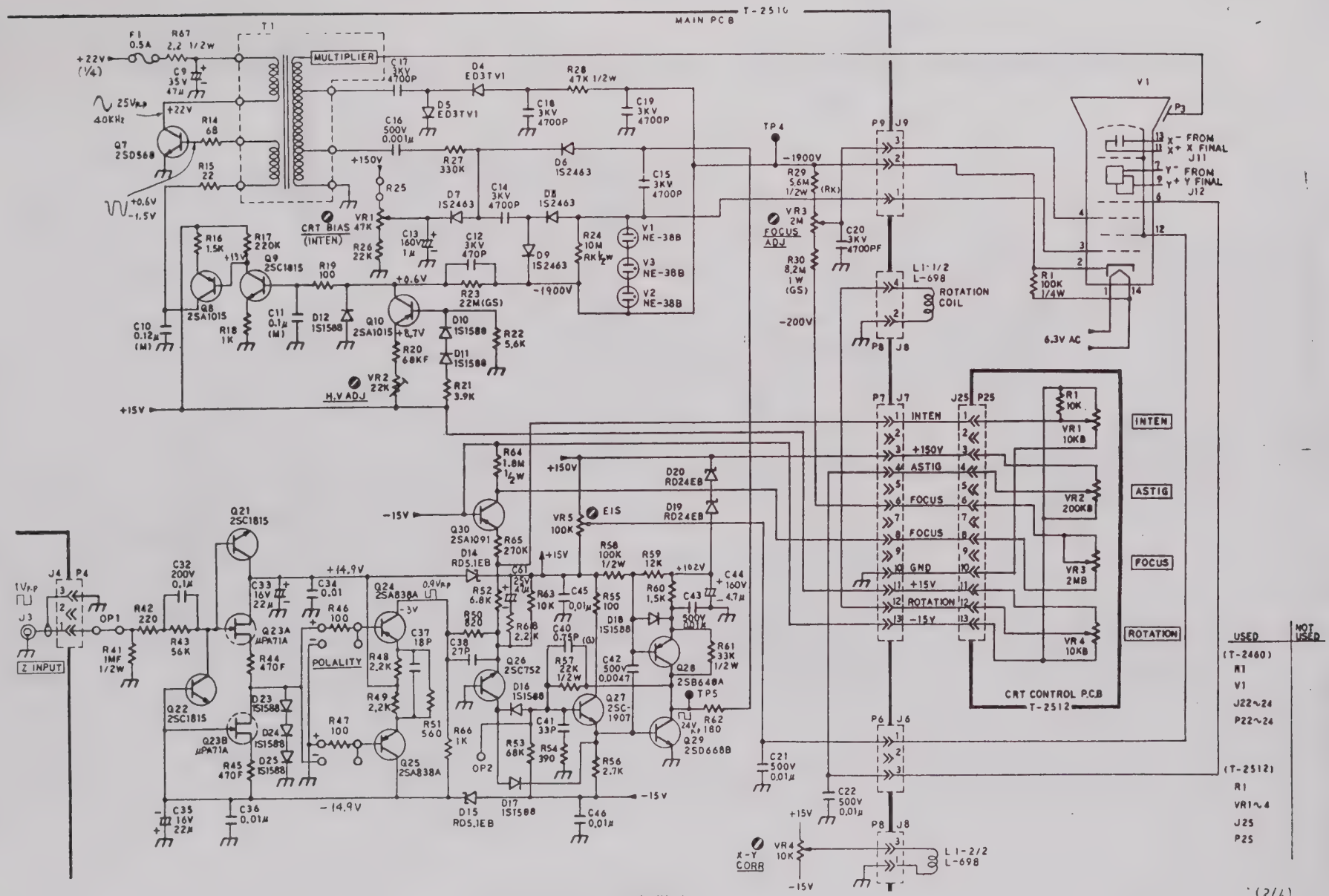
7. BLOCK DIAGRAM





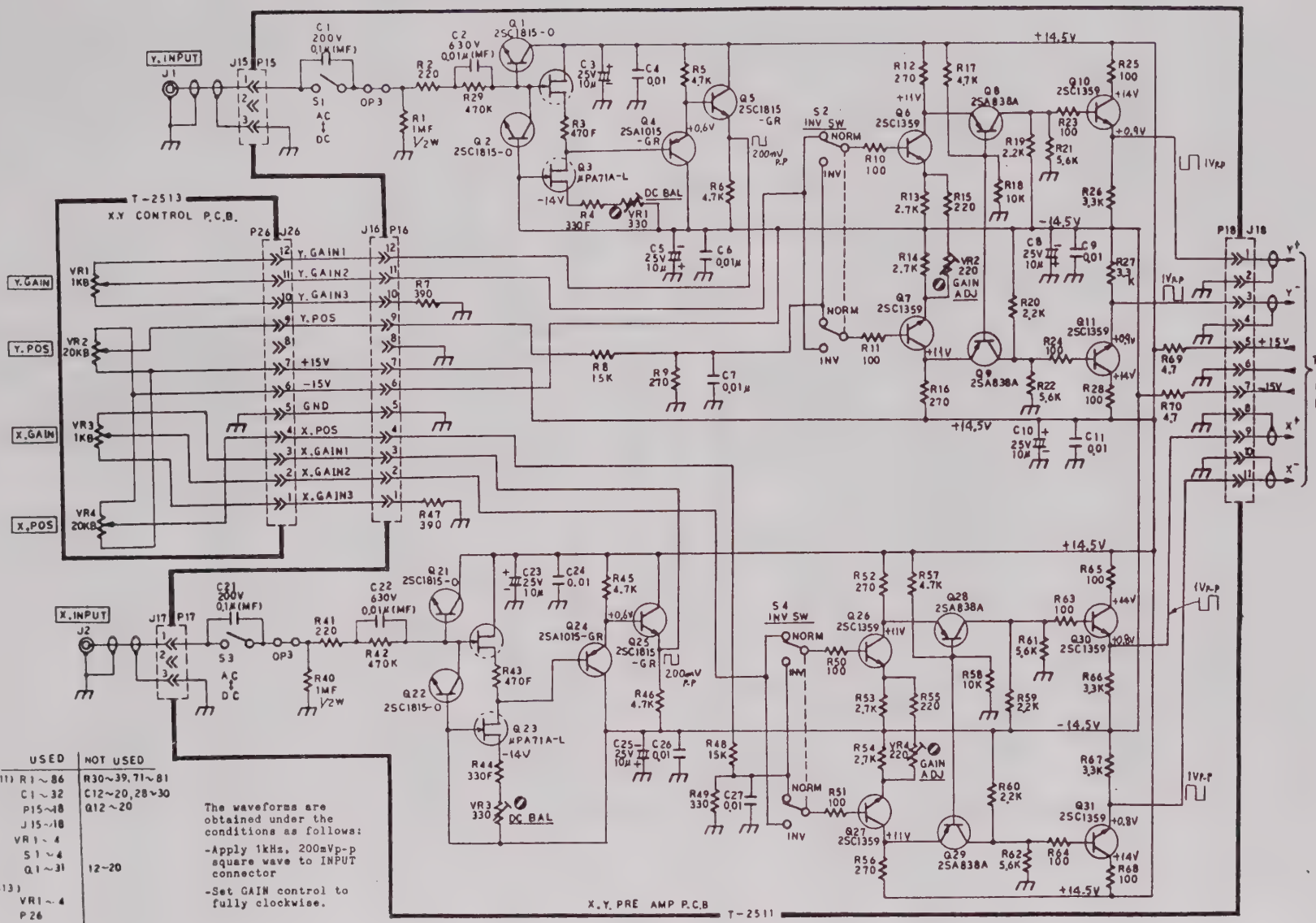
USED	NOT USED
R1 ~ 119	31~40, 69~70, 90~100
C1 ~ 61	23~31, 39, 47~50, 59, 60
VR2	4, 6~10
VC1 ~ 2	
D1 ~ 34	13, 21, 22, 26~30
Q1 ~ 54	11~20, 31~40
J1 ~ 12	
P1 ~ 12	

POWER SUPPLY



CRT and Z-AXIS AMPLIFIER

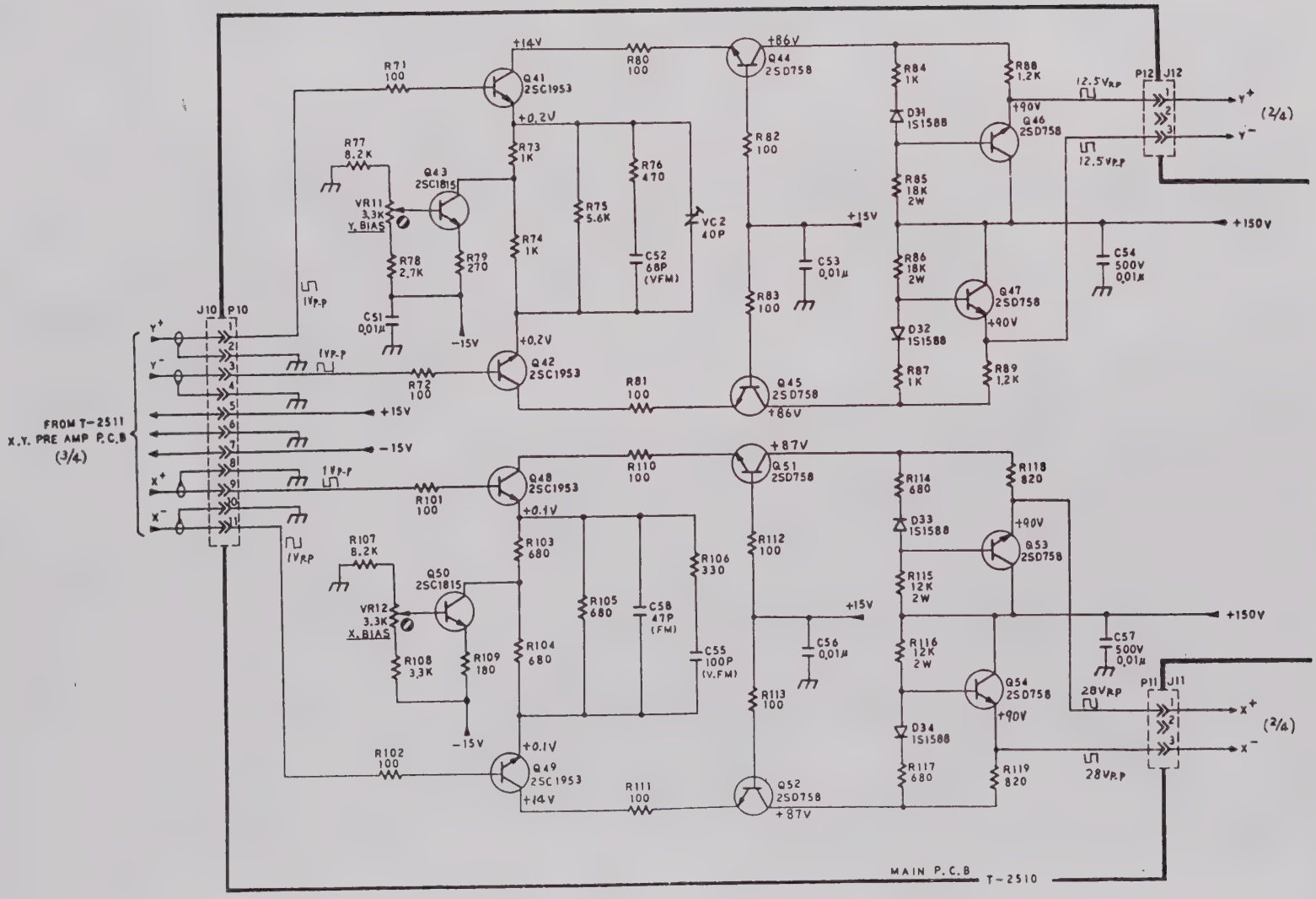
(2/4)



	USED	NOT USED
(T-2511)	R1~86	R30~39, 71~81
	C1~32	C12~20, 28~30
	P15~18	Q12~20
	J15~18	
	VR1~4	
	S1~4	
	Q1~31	12~20
(T-2513)		
	VR1~4	
	P26	
	J26	

The waveforms are obtained under the conditions as follows:

- Apply 1kHz, 200mVp-p square wave to INPUT connector
- Set GAIN control to fully clockwise.



X, Y FINAL AMPLIFIER (4/4)

No.	LDR PT No.	DESCRIPTION			
*** MAIN FRAME ***					
-RESISTOR-					
R1	1010104008	CARBON FILM	100K OHM	5%	1/4W
-DIODE-					
D1	3130005006	LED	SLP-751		
-CRT-					
V1	3710046004	CRT	150CKB31		
-TRANSFORMER-					
T1	3800443005	TRANSFORMER	J-443B		
-COIL-					
L1	3900698006	BEAM ROTATOR	L-698		
-SWITCH-					
S1	4020138009	PUSH	ESB-70702V "POWER"		
-FUSE-					
F1	4363745000	TIME LAG	ST4 400mA "180V-264V"		
F1	4363760006	TIME LAG	ST4 800mA "90V-132V"		
-MISCELLANOUS-					
	4371009003	FUSE HOLDER	FH-032(6.35X31.8)		
	4320008000	CRT SOCKET	NO.1231-4		
*** MAIN BOARD		T-2510 ***			
-RESISTORS-					
R1	1210104004	METAL OXIDE	100K OHM	5%	1W
R2	1010829002	CARBON FILM	8.2 OHM	5%	1/4W
R3	1010223006	CARBON FILM	22K OHM	5%	1/4W
R4	1010103006	CARBON FILM	10K OHM	5%	1/4W
R5	1311503002	METAL FILM	150K OHM	1%	1/4W
R6	1311502000	METAL FILM	15K OHM	1%	1/4W
R7	1010472007	CARBON FILM	4.7K OHM	5%	1/4W
R8	1010229008	CARBON FILM	2.2 OHM	5%	1/4W
R9	1010102004	CARBON FILM	1K OHM	5%	1/4W
R10	1010103006	CARBON FILM	10K OHM	5%	1/4W
R11	1311502000	METAL FILM	15K OHM	1%	1/4W
R12	1311502000	METAL FILM	15K OHM	1%	1/4W
R13	1010102004	CARBON FILM	1K OHM	5%	1/4W
R14	1010680004	CARBON FILM	68 OHM	5%	1/4W
R15	1010220000	CARBON FILM	22 OHM	5%	1/4W
R16	1010152009	CARBON FILM	1.5K OHM	5%	1/4W
R17	1010224008	CARBON FILM	220K OHM	5%	1/4W
R18	1010102004	CARBON FILM	1K OHM	5%	1/4W
R19	1010101002	CARBON FILM	100 OHM	5%	1/4W
R20	1316802002	METAL FILM	68K OHM	1%	1/4W
R21	1010392009	CARBON FILM	3.9K OHM	5%	1/4W
R22	1010562008	CARBON FILM	5.6K OHM	5%	1/4W
R23	1190007004	METAL GLAZE	22M OHM	5%	1W
R24	1130106013	METAL FILM	10M OHM	10%	1/2W
R25	1010000006		0 OHM		

No.	LDR PT No.	DESCRIPTION			
(T-2510	CONT'D)				
R26	1010223006	CARBON FILM	22K OHM	5%	1/4W
R27	1010334005	CARBON FILM	330K OHM	5%	1/4W
R28	1020473006	CARBON FILM	47K OHM	5%	1/2W
R29	1130565006	METAL FILM	5.6M OHM	10%	1/2W
R30	1190013009	METAL GLAZE	8.2M OHM	5%	1W
R41	1331004008	METAL FILM	1.00M OHM	1%	1/2W
R42	1010221002	CARBON FILM	220 OHM	5%	1/4W
R43	1010563000	CARBON FILM	56K OHM	5%	1/4W
R44	1314700002	METAL FILM	470 OHM	1%	1/4W
R45	1314700002	METAL FILM	470 OHM	1%	1/4W
R46	1010101002	CARBON FILM	100 OHM	5%	1/4W
R47	1010101002	CARBON FILM	100 OHM	5%	1/4W
R48	1010222004	CARBON FILM	2.2K OHM	5%	1/4W
R49	1010222004	CARBON FILM	2.2K OHM	5%	1/4W
R50	1010821006	CARBON FILM	820 OHM	5%	1/4W
R51	1010561006	CARBON FILM	560 OHM	5%	1/4W
R52	1010682008	CARBON FILM	6.8K OHM	5%	1/4W
R53	1010683000	CARBON FILM	68K OHM	5%	1/4W
R54	1010391007	CARBON FILM	390 OHM	5%	1/4W
R55	1010101002	CARBON FILM	100 OHM	5%	1/4W
R56	1010272009	CARBON FILM	2.7K OHM	5%	1/4W
R57	1020223003	CARBON FILM	22K OHM	5%	1/2W
R58	1020104005	CARBON FILM	100K OHM	5%	1/2W
R59	1010123002	CARBON FILM	12K OHM	5%	1/4W
R60	1010152009	CARBON FILM	1.5K OHM	5%	1/4W
R61	1020333000	CARBON FILM	33K OHM	5%	1/2W
R62	1010181006	CARBON FILM	180 OHM	5%	1/4W
R63	1010103006	CARBON FILM	10K OHM	5%	1/4W
R64	1020185001	CARBON FILM	1.8M OHM	5%	1/2W
R65	1010274003	CARBON FILM	270K OHM	5%	1/4W
R66	1010102004	CARBON FILM	1K OHM	5%	1/4W
R67	1020229005	CARBON FILM	2.2 OHM	5%	1/2W
R68	1010222004	CARBON FILM	2.2K OHM	5%	1/4W
R71	1010101002	CARBON FILM	100 OHM	5%	1/4W
R72	1010101002	CARBON FILM	100 OHM	5%	1/4W
R73	1010102004	CARBON FILM	1K OHM	5%	1/4W
R74	1010102004	CARBON FILM	1K OHM	5%	1/4W
R75	1010562008	CARBON FILM	5.6K OHM	5%	1/4W
R76	1010471005	CARBON FILM	470 OHM	5%	1/4W
R77	1010822008	CARBON FILM	8.2K OHM	5%	1/4W
R78	1010272009	CARBON FILM	2.7K OHM	5%	1/4W
R79	1010271007	CARBON FILM	270 OHM	5%	1/4W
R80	1010101002	CARBON FILM	100 OHM	5%	1/4W
R81	1010101002	CARBON FILM	100 OHM	5%	1/4W
R82	1010101002	CARBON FILM	100 OHM	5%	1/4W
R83	1010101002	CARBON FILM	100 OHM	5%	1/4W
R84	1010102004	CARBON FILM	1K OHM	5%	1/4W
R85	1220183003	METAL OXIDE	18K OHM	5%	2W
R86	1220183003	METAL OXIDE	18K OHM	5%	2W
R87	1010102004	CARBON FILM	1K OHM	5%	1/4W
R88	1010122000	CARBON FILM	1.2K OHM	5%	1/4W
R89	1010122000	CARBON FILM	1.2K OHM	5%	1/4W
R101	1010101002	CARBON FILM	100 OHM	5%	1/4W
R102	1010101002	CARBON FILM	100 OHM	5%	1/4W
R103	1010681006	CARBON FILM	680 OHM	5%	1/4W
R104	1010681006	CARBON FILM	680 OHM	5%	1/4W
R105	1010681006	CARBON FILM	680 OHM	5%	1/4W

No.	LDR PT No.	DESCRIPTION			
(T-2510	CONT'D)				
R106	1010331009	CARBON FILM	330 OHM	5%	1/4W
R107	1010822009	CARBON FILM	8.2K OHM	5%	1/4W
R108	1010733001	CARBON FILM	73K OHM	5%	1/4W
R109	1010181006	CARBON FILM	180 OHM	5%	1/4W
R110	1010101002	CARBON FILM	100 OHM	5%	1/4W
R111	1010101002	CARBON FILM	100 OHM	5%	1/4W
R112	1010101002	CARBON FILM	100 OHM	5%	1/4W
R113	1010101002	CARBON FILM	100 OHM	5%	1/4W
R114	1010681006	CARBON FILM	680 OHM	5%	1/4W
R115	1220123005	METAL OXIDE	12K OHM	5%	2W
R116	1220123005	METAL OXIDE	12K OHM	5%	2W
R117	1010681006	CARBON FILM	680 OHM	5%	1/4W
R118	1010821006	CARBON FILM	820 OHM	5%	1/4W
R119	1010821006	CARBON FILM	820 OHM	5%	1/4W
-VARIABLE RESISTORS-					
VR1	1712013003	METAL GLAZE	47K OHM	25%	1/2W
VR2	1712011009	METAL GLAZE	22K OHM	25%	1/2W
VR3	1712019005	METAL GLAZE	2.2M OHM	25%	1/2W
VR4	1712010007	METAL GLAZE	10K OHM	25%	1/2W
VR5	1712014005	METAL GLAZE	100K OHM	25%	1/2W
VR11	1712008000	METAL GLAZE	3.3K OHM	25%	1/2W
VR12	1712008000	METAL GLAZE	3.3K OHM	25%	1/2W
-CAPACITORS-					
C1	2330044003	ELECTROLYTIC	100uF	20%	315V
C2	2120470016	MICA	47pF	10%	500V
C3	2280479014	ELECTROLYTIC	4.7uF	20%	250V
C4	2330027003	ELECTROLYTIC	2200uF	20%	35V
C5	2240100015	ELECTROLYTIC	10uF	20%	25V
C6	2330027003	ELECTROLYTIC	2200uF	20%	35V
C7	2250109010	ELECTROLYTIC	1uF	20%	50V
C8	2240100015	ELECTROLYTIC	10uF	20%	25V
C9	2320041000	ELECTROLYTIC	470uF	20%	35V
C10	2140124011	PLASTIC FILM	0.12uF	10%	50V
C11	2140104015	PLASTIC FILM	0.1uF	10%	50V
C12	2090005010	CERAMIC	470pF	10%	3KV
C13	2270109005	ELECTROLYTIC	1uF	20%	160V
C14	2090013000	CERAMIC	4700pF		3KV
C15	2090013000	CERAMIC	4700pF		3KV
C16	2020102000	CERAMIC	1000pF		500V
C17	2090013000	CERAMIC	4700pF		3KV
C18	2090013000	CERAMIC	4700pF		3KV
C19	2090013000	CERAMIC	4700pF		3KV
C20	2090013000	CERAMIC	4700pF		3KV
C21	2020103002	CERAMIC	0.01uF		500V
C22	2020103002	CERAMIC	0.01uF		500V
C32	2160104019	PLASTIC FILM	0.1uF	10%	200V
C33	2230220018	ELECTROLYTIC	22uF	20%	16V
C34	2010103005	CERAMIC	0.01uF		50V
C35	2230220018	ELECTROLYTIC	22uF	20%	16V
C36	2010103005	CERAMIC	0.01uF		50V
C37	2120180008	MICA	18pF	10%	500V
C38	2120270009	MICA	27pF	10%	500V
C40	2195004007	COMPOSITION	0.75pF	10%	500V
C41	2120330001	MICA	33pF	10%	500V
C42	2020472003	CERAMIC	4700pF		500V

No.	LDR PT No.	DESCRIPTION			
(T-2510	CONT'D)				
C43	2020103002	CERAMIC	0.01uF		500V
C44	2270479017	ELECTROLYTIC	4.7uF	20%	160V
C45	2010103005	CERAMIC	0.01uF		50V
C46	2010103005	CERAMIC	0.01uF		50V
C51	2010103005	CERAMIC	0.01uF		50V
C52	2110680001	MICA	68pF	10%	50V
C53	2010103005	CERAMIC	0.01uF		50V
C54	2020103002	CERAMIC	0.01uF		500V
C55	2110101009	MICA	100pF	10%	50V
C56	2010103005	CERAMIC	0.01uF		50V
C57	2020103002	CERAMIC	0.01uF		500V
C58	2120680008	MICA	68pF	10%	500V
C61	2240470018	ELECTROLYTIC	47uF	20%	25V
-VARIABLE CAPACITOR-					
VC2	2910040009	CERAMIC	4-40pF	250V	
-TRANSISTORS-					
Q1	3032551007	NPN	2SC2551-O		
Q2	3040859000	NPN	2SD859-Q		
Q3	3011091009	PNP	2SA1091-R		
Q4	3011015003	PNP	2SA1015-O or Y		
Q5	3020435006	PNP	2SB435-O		
Q6	3031815009	NPN	2SC1815-O or Y		
Q7	3040568009	NPN	2SD568L		
Q8	3011015003	PNP	2SA1015-O or Y		
Q9	3031815009	NPN	2SC1815-O or Y		
Q10	3011015003	PNP	2SA1015-O or Y		
Q21	3031815009	NPN	2SC1815-O or Y		
Q22	3031815009	NPN	2SC1815-O or Y		
Q23	3090026008	FET DUAL	uPA71A-L		
Q24	3010838010	PNP	2SA838B		
Q25	3010838010	PNP	2SA838B		
Q26	3030752005	NPN	2SC752(G)TM-O		
Q27	3031907004	NPN	2SC1907		
Q28	3020648003	PNP	2SB648A		
Q29	3040668003	NPN	2SD668		
Q30	3011091009	PNP	2SA1091-R		
Q41	3031953001	NPN	2SC1953-S		
Q42	3031953001	NPN	2SC1953-S		
Q43	3031815009	NPN	2SC1815-O or Y		
Q44	3040758004	NPN	2SD758C		
Q45	3040758004	NPN	2SD758C		
Q46	3040758004	NPN	2SD758C		
Q47	3040758004	NPN	2SD758C		
Q48	3031953001	NPN	2SC1953-S		
Q49	3031953001	NPN	2SC1953-S		
Q50	3031815009	NPN	2SC1815-O or Y		
Q51	3040758004	NPN	2SD758C		
Q52	3040758004	NPN	2SD758C		
Q53	3040758004	NPN	2SD758C		
Q54	3040758004	NPN	2SD758C		

No.	LDR PT No.	DESCRIPTION			
(T-2510	CONT'D)				
-DIODES-					
D1	3110050007	BRIDGE RECTIFIER	M-04		
D2	3110042008	BRIDGE RECTIFIER	M-02		
D3	3110042008	BRIDGE RECTIFIER	M-02		
D4	3110051009	RECTIFIER HV	EQ-3TV	3KV	
D5	3110051009	RECTIFIER HV	EQ-3TV	3KV	
D6	3110038007	DETECTOR	1S2463		
D7	3110038007	DETECTOR	1S2463		
D8	3110038007	DETECTOR	1S2463		
D9	3110038007	DETECTOR	1S2463		
D10	3110006004	DETECTOR	1S1588		
D11	3110006004	DETECTOR	1S1588		
D12	3110006004	DETECTOR	1S1588		
D14	3120024003	ZENER	RD5.1EB	5.1V	
D15	3120024003	ZENER	RD5.1EB	5.1V	
D16	3110006004	DETECTOR	1S1588		
D17	3110006004	DETECTOR	1S1588		
D18	3110006004	DETECTOR	1S1588		
D19	3120060007	ZENER	RD24EB	24V	
D20	3120060007	ZENER	RD24EB	24V	
D23	3110006004	DETECTOR	1S1588		
D24	3110006004	DETECTOR	1S1588		
D25	3110006004	DETECTOR	1S1588		
D31	3110006004	DETECTOR	1S1588		
D32	3110006004	DETECTOR	1S1588		
D33	3110006004	DETECTOR	1S1588		
D34	3110006004	DETECTOR	1S1588		
-INTEGRATED CIRCUITS-					
IC1	3210741075	OP AMP	MC1741CP1		
IC2	3210741075	OP AMP	MC1741CP1		
IC3	3217815007	REGULATOR	HA17815P	+15V	
-TRANSFORMER-					
T1	3810023000	TRANSFORMER	HYD-0495-(D) HV UNIT		
-FUSE-					
F1	4363150009	NORMAL BLOW	BEQ 500mA		
-MISCELLANOUS-					
	4360027002	NEON BULB	NE-38B		
	4360027002	NEON BULB	NE-38B		
	4360027002	NEON BULB	NE-38B		
	4371008001	FUSE CLIP	S-N5053		

*** X,Y PRE-AMP BOARD T-2511 ***

-RESISTORS-					
R1	1331004008	METAL FILM	1.00M OHM	1%	1/2W
R2	1010221002	CARBON FILM	220 OHM	5%	1/4W
R3	1314700002	METAL FILM	470 OHM	1%	1/4W
R4	1313300000	METAL FILM	330 OHM	1%	1/4W
R5	1010472007	CARBON FILM	4.7K OHM	5%	1/4W
R6	1010472007	CARBON FILM	4.7K OHM	5%	1/4W

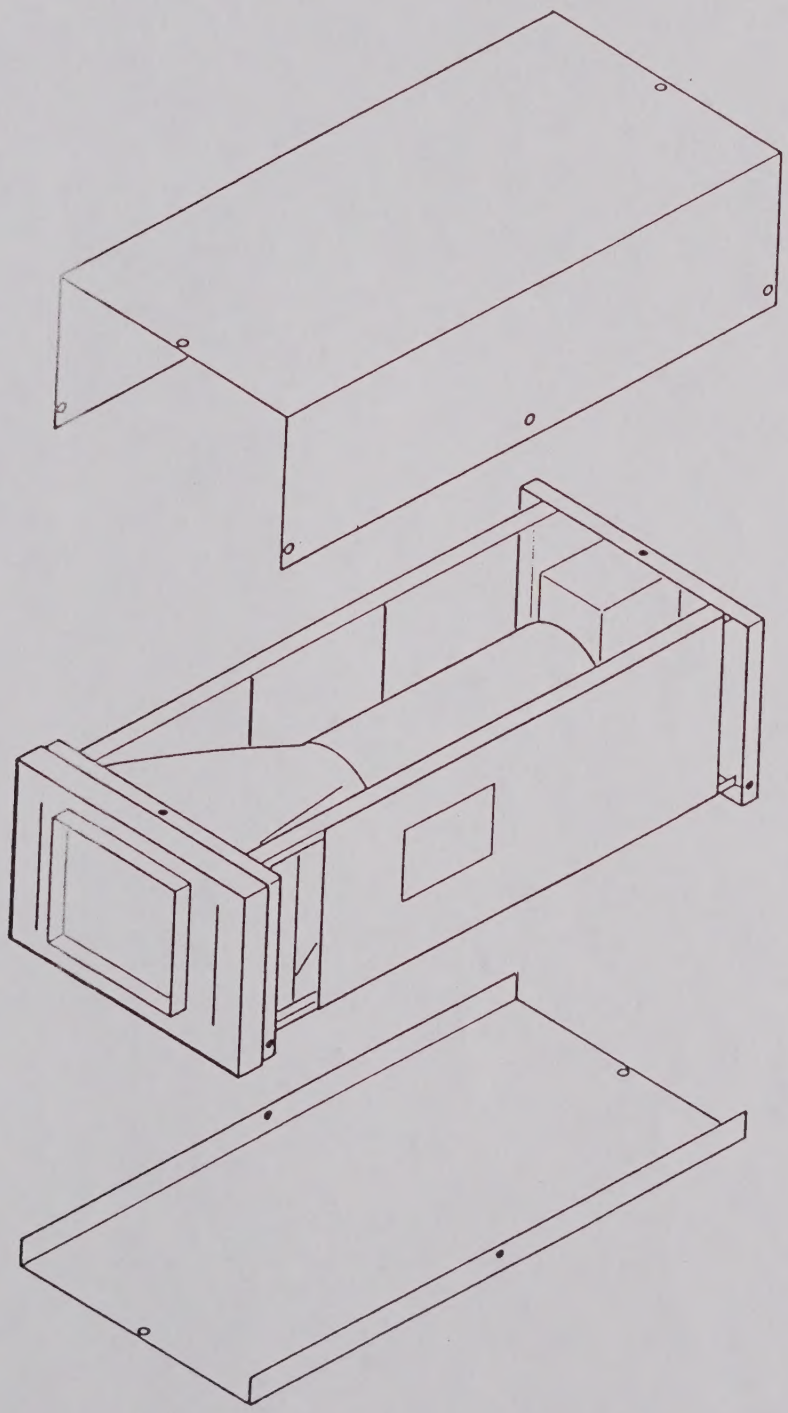
No.	LDR PT No.	DESCRIPTION			
(T-2511	CONT'D)				
R7	1010391007	CARBON FILM	390 OHM	5%	1/4W
R8	1010153001	CARBON FILM	15K OHM	5%	1/4W
R9	1010271007	CARBON FILM	270 OHM	5%	1/4W
R10	1010101002	CARBON FILM	100 OHM	5%	1/4W
R11	1010101002	CARBON FILM	100 OHM	5%	1/4W
R12	1010271007	CARBON FILM	270 OHM	5%	1/4W
R13	1010272009	CARBON FILM	2.7K OHM	5%	1/4W
R14	1010272009	CARBON FILM	2.7K OHM	5%	1/4W
R15	1010221002	CARBON FILM	220 OHM	5%	1/4W
R16	1010271007	CARBON FILM	270 OHM	5%	1/4W
R17	1010472007	CARBON FILM	4.7K OHM	5%	1/4W
R18	1010103006	CARBON FILM	10K OHM	5%	1/4W
R19	1010222004	CARBON FILM	2.2K OHM	5%	1/4W
R20	1010222004	CARBON FILM	2.2K OHM	5%	1/4W
R21	1010562008	CARBON FILM	5.6K OHM	5%	1/4W
R22	1010562008	CARBON FILM	5.6K OHM	5%	1/4W
R23	1010101002	CARBON FILM	100 OHM	5%	1/4W
R24	1010101002	CARBON FILM	100 OHM	5%	1/4W
R25	1010101002	CARBON FILM	100 OHM	5%	1/4W
R26	1010332001	CARBON FILM	3.3K OHM	5%	1/4W
R27	1010332001	CARBON FILM	3.3K OHM	5%	1/4W
R28	1010101002	CARBON FILM	100 OHM	5%	1/4W
R29	1010474001	CARBON FILM	470K OHM	5%	1/4W
R40	1331004008	METAL FILM	1.00M OHM	1%	1/2W
R41	1010221002	CARBON FILM	220 OHM	5%	1/4W
R42	1010474001	CARBON FILM	470K OHM	5%	1/4W
R43	1314700002	METAL FILM	470 OHM	1%	1/4W
R44	1313300000	METAL FILM	330 OHM	1%	1/4W
R45	1010472007	CARBON FILM	4.7K OHM	5%	1/4W
R46	1010472007	CARBON FILM	4.7K OHM	5%	1/4W
R47	1010391007	CARBON FILM	390 OHM	5%	1/4W
R48	1010153001	CARBON FILM	15K OHM	5%	1/4W
R49	1010331009	CARBON FILM	330 OHM	5%	1/4W
R50	1010101002	CARBON FILM	100 OHM	5%	1/4W
R51	1010101002	CARBON FILM	100 OHM	5%	1/4W
R52	1010271007	CARBON FILM	270 OHM	5%	1/4W
R53	1010272009	CARBON FILM	2.7K OHM	5%	1/4W
R54	1010272009	CARBON FILM	2.7K OHM	5%	1/4W
R55	1010221002	CARBON FILM	220 OHM	5%	1/4W
R56	1010271007	CARBON FILM	270 OHM	5%	1/4W
R57	1010472007	CARBON FILM	4.7K OHM	5%	1/4W
R58	1010103006	CARBON FILM	10K OHM	5%	1/4W
R59	1010222004	CARBON FILM	2.2K OHM	5%	1/4W
R60	1010222004	CARBON FILM	2.2K OHM	5%	1/4W
R61	1010562008	CARBON FILM	5.6K OHM	5%	1/4W
R62	1010562008	CARBON FILM	5.6K OHM	5%	1/4W
R63	1010101002	CARBON FILM	100 OHM	5%	1/4W
R64	1010101002	CARBON FILM	100 OHM	5%	1/4W
R65	1010101002	CARBON FILM	100 OHM	5%	1/4W
R66	1010332001	CARBON FILM	3.3K OHM	5%	1/4W
R67	1010332001	CARBON FILM	3.3K OHM	5%	1/4W
R69	1010101002	CARBON FILM	100 OHM	5%	1/4W
R69	1010479001	CARBON FILM	4.7 OHM	5%	1/4W
R70	1010479001	CARBON FILM	4.7 OHM	5%	1/4W

No.	LDR PT No.	DESCRIPTION			
T-2511 CONT D)					
-VARIABLE RESISTORS-					
VR1	1712004002	METAL GLAZE	33K OHM	25%	1/2W
VR2	1712003000	METAL GLAZE	220 OHM	25%	1/2W
VR3	1712004002	METAL GLAZE	33K OHM	25%	1/2W
VR4	1712003000	METAL GLAZE	220 OHM	25%	1/2W
-CAPACITORS-					
C1	2160104019	PLASTIC FILM	0.1uF	10%	200V
C2	2180103002	PLASTIC FILM	0.01uF	20%	630V
C3	2240100015	ELECTROLYTIC	10uF	20%	25V
C4	2010103005	CERAMIC	0.01uF		50V
C5	2240100015	ELECTROLYTIC	10uF	20%	25V
C6	2010103005	CERAMIC	0.01uF		50V
C7	2010103005	CERAMIC	0.01uF		50V
C8	2240100015	ELECTROLYTIC	10uF	20%	25V
C9	2010103005	CERAMIC	0.01uF		50V
C10	2240100015	ELECTROLYTIC	10uF	20%	25V
C11	2010103005	CERAMIC	0.01uF		50V
C21	2160104019	PLASTIC FILM	0.1uF	10%	200V
C22	2180103002	PLASTIC FILM	0.01uF	20%	630V
C23	2240100015	ELECTROLYTIC	10uF	20%	25V
C24	2010103005	CERAMIC	0.01uF		50V
C25	2240100015	ELECTROLYTIC	10uF	20%	25V
C26	2010103005	CERAMIC	0.01uF		50V
C27	2010103005	CERAMIC	0.01uF		50V
-TRANSISTORS-					
Q1	3031815009	NPN	2SC1815-O or Y		
Q2	3031815009	NPN	2SC1815-O or Y		
Q3	3090026008	FET DUAL	uPA71A-L		
Q4	3011015021	PNP	2SA1015-GR		
Q5	3031815027	NPN	2SC1815-GR		
Q6	3031359009	NPN	2SC1359		
Q7	3031359009	NPN	2SC1359		
Q8	3010838010	PNP	2SA838B		
Q9	3010838010	PNP	2SA838B		
Q10	3031359009	NPN	2SC1359		
Q11	3031359009	NPN	2SC1359		
Q21	3031815009	NPN	2SC1815-O or Y		
Q22	3031815009	NPN	2SC1815-O or Y		
Q23	3090026008	FET DUAL	uPA71A-L		
Q24	3011015021	PNP	2SA1015-GR		
Q25	3031815027	NPN	2SC1815-GR		
Q26	3031359009	NPN	2SC1359		
Q27	3031359009	NPN	2SC1359		
Q28	3010838010	PNP	2SA838B		
Q29	3010838010	PNP	2SA838B		
Q30	3031359009	NPN	2SC1359		
Q31	3031359009	NPN	2SC1359		
-SWITCHES-					
S1	4030061007	SLIDE	SSS-322		
S2	4030061007	SLIDE	SSS-322		
S3	4030061007	SLIDE	SSS-322		
S4	4030061007	SLIDE	SSS-322		

No.	LDR PT No.	DESCRIPTION				
(T-2511 CONT D)						
-PC BOARD-						
	5902511004		T-2511			
*** CRT CONTROL BOARD			T-2512 ***			
-RESISTOR-						
R1	1010103006	CARBON FILM	10K OHM	5%	1/4W	
-VARIABLE RESISTORS-						
VR1	1815004008	CARBON FILM	10K OHM	20%	1/8W	"INTEN"
VR2	1815003051	CARBON FILM	200K OHM	20%	1/8W	"ASTIG"
VR3	1815004035	CARBON FILM	2M OHM	20%	1/8W	"FOCUS"
VR4	1815003033	CARBON FILM	10K OHM	20%	1/8W	"ROTATION"
-PC BOARD-						
	5902512006		T-2512			
*** X,Y CONTROL BOARD			T-2513 ***			
-VARIABLE RESISTORS-						
VR1	1815003006	CARBON FILM	1K OHM	20%	1/8W	"Y GAIN"
VR2	1815004017	CARBON FILM	20K OHM	20%	1/8W	"Y POSITION"
VR3	1815003006	CARBON FILM	1K OHM	20%	1/8W	"X GAIN"
VR4	1815004017	CARBON FILM	20K OHM	20%	1/8W	"X POSITION"
-PC BOARD-						
	5902513008		T-2513			

10. CABINET REMOVAL

- Take eight screws off to remove the Top cover.
- Take two(four) screws to remove the Bottom cover.



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